

MISSOULA HOERNER-WALDORF #1

MISSOULA COUNTY

The Hoerner-Waldorf #1 site is located about 12 miles northwest of Missoula at 46 57 03 N and 114 10 50 W (Site No. 81 on Map II-1). Elevation at the site is 3,139 feet. The site was established by Hoerner-Waldorf to monitor particulate concentrations in the air and meteorological conditions in the area.

Data gathering at the site commenced on July 1, 1977. Due to problems with the data set, only data from November 1, 1977, through March 31, 1982, were analyzed for this *Atlas*. The data set consists of hourly averages of wind speed and wind direction, obtained by manually reducing the data from stripchart records. Anemometer height was 10 meters.

Data recovery was good to excellent, ranging from 74.3 percent in January to 99.9 percent in March. Overall data recovery was 89.0 percent. Winds were monitored long enough to adequately represent the wind resource at this location. The data, however, are representative only of a limited area of the Missoula Valley near the site.

Average annual wind speed at this site was 5.1 miles per hour. Average monthly wind speeds varied from 3.8 miles per hour in December and January to 6.5 miles per hour in April.

Average monthly wind power ranged from 14.8 watts/m² in October to 45.4 watts/m² in April. Average annual wind power was 30.5 watts/m².

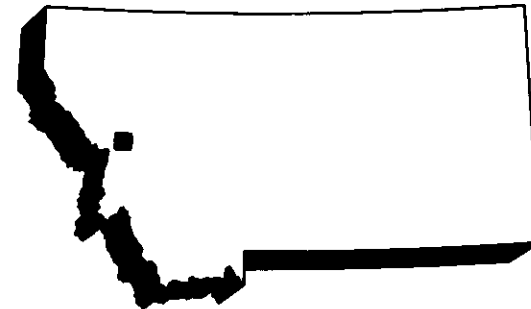


Table IV - 113
Monthly Wind Speed Distribution
MISSOULA COUNTY - MISSOULA HOERNER-WALDORF #1
11/01/77 - 03/31/82

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	
SPEED	CALM	9.6	5.4	4.5	0.9	0.9	1.1	1.4	3.0	1.9	3.8	6.2	6.6	3.9	CALM
	0.1-1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.7	1.5	0.1- 0.4
	1.1-2.0	15.4	8.4	5.3	3.2	2.4	2.5	3.5	5.6	5.9	7.1	10.9	10.0	6.8	0.5- 0.9
	2.1-3.0	26.3	21.7	16.6	12.8	11.9	12.3	15.3	15.4	16.2	23.8	25.0	17.2	18.0	1.0- 1.3
	3.1-4.0	17.2	22.5	20.1	18.3	18.4	20.1	21.3	19.0	23.3	27.2	20.0	15.4	20.0	1.4- 1.8
	4.1-5.0	9.7	11.9	12.4	13.9	13.4	15.2	14.7	15.3	14.8	13.8	11.3	9.9	12.9	1.9- 2.2
	5.1-6.0	5.4	7.7	7.1	8.7	8.6	10.8	8.3	7.6	8.8	6.9	6.7	5.3	7.6	2.3- 2.7
	6.1-7.0	2.5	4.0	4.4	5.7	6.8	6.6	5.2	5.5	4.9	3.7	3.4	2.9	4.6	2.8- 3.1
	7.1-8.0	2.4	2.5	4.1	5.0	6.1	4.7	4.3	3.2	4.3	2.7	2.7	2.5	3.7	3.2- 3.6
	8.1-9.0	1.4	2.2	3.9	3.8	5.3	4.2	3.2	3.8	3.3	2.1	1.3	2.6	3.1	3.7- 4.0
MILES	9.1-10.0	0.9	1.5	3.0	3.8	4.7	3.3	3.0	3.2	3.0	1.3	1.4	1.4	2.5	4.1- 4.5
	10.1-11.0	1.2	1.5	3.5	3.6	4.9	3.4	3.4	3.3	2.4	1.4	1.1	1.7	2.6	4.6- 4.9
	11.1-12.0	1.3	1.2	2.4	3.8	2.6	2.8	2.5	2.7	2.5	1.0	1.0	1.1	2.0	5.0- 5.4
	12.1-13.0	0.8	0.9	2.0	2.8	3.5	3.3	2.9	2.5	2.2	1.0	1.0	1.3	2.0	5.5- 5.8
	13.1-14.0	0.5	0.8	2.3	2.8	3.0	2.6	2.1	2.2	1.4	1.0	1.0	1.0	1.7	5.9- 6.3
	14.1-15.0	0.4	1.0	1.6	2.1	1.8	1.7	2.5	2.0	1.3	0.9	0.8	1.2	1.4	6.4- 6.7
	15.1-16.0	0.4	1.1	2.1	2.2	1.7	1.3	2.0	1.6	1.8	0.3	1.0	1.1	1.4	6.8- 7.2
	16.1-17.0	0.6	0.9	1.1	2.0	1.0	0.9	1.4	1.0	0.7	0.5	1.3	0.6	1.0	7.3- 7.6
	17.1-18.0	0.6	0.7	0.8	1.3	1.4	1.0	1.2	1.3	0.3	0.5	0.8	0.8	0.9	7.7- 8.0
	18.1-19.0	0.9	0.5	0.8	1.2	0.4	1.0	0.8	0.7	0.2	0.4	0.5	0.5	0.7	8.1- 8.5
UNRECOVERED	19.1-20.0	0.4	0.1	0.5	0.7	0.5	0.6	0.3	0.4	0.2	0.2	0.6	0.3	0.4	8.6- 8.9
	20.1-25.0	1.6	3.2	1.6	1.3	0.4	0.6	0.9	0.8	0.4	0.5	1.7	0.8	1.2	9.0-11.2
	25.1-30.0	0.2	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.1	11.3-13.4
	30.1-35.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5-15.6
	35.1-40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.7-17.9
	>40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	>17.9
	AVERAGE														
	SPEED (MPH)	3.8	4.7	5.5	6.5	6.2	5.9	5.8	5.6	5.0	4.0	4.4	3.8	5.1	
	AVERAGE														
	SPEED (M/SEC)	1.7	2.1	2.5	2.9	2.8	2.7	2.6	2.5	2.2	1.8	2.0	1.7	2.3	
AVERAGE															
WIND POWER															
(WATTS/M**2)	25.7	36.5	35.6	45.4	32.5	31.6	35.6	30.4	21.9	14.8	29.9	22.4	30.5		
PERCENT DATA															
RECOVERY	74.3	86.9	99.9	99.0	92.7	82.0	99.1	98.0	74.4	74.6	98.9	87.8	89.0		

ANEMOMETER HEIGHT = 10 METERS = 33 FEET
 NUMBER OF OBSERVATIONS = 34442
 PERCENTAGE DATA RECOVERY = 89.0

SOURCE: GEORESEARCH, INC.

MISSOULA NWS AIRPORT

MISSOULA COUNTY

The Missoula NWS Airport is located approximately 5 miles northwest of Missoula at 46 55 40 N and 114 05 50 W (Site No. 84 on Map II-1). Elevation at the airport is 3,214 feet. Meteorological data have been collected here for many years by the National Weather Service.

These data, primarily collected for aviation and weather forecasting uses, consist of short-term (5 minutes or less) averages of wind speed and wind direction, as well as other meteorological parameters. Data were gathered once per hour. The data have been analyzed by Battelle Pacific Northwest Laboratories. Because of changes in anemometer height and reporting interval, the data set was broken into three periods for analysis: January 1, 1948, through April 3, 1958; April 4, 1958, through December 31, 1964; and January 1, 1965, through December 31, 1978. Only data from the most recent period were selected for inclusion in the *Montana Wind Energy Atlas*.

The data set for Missoula consists of summaries of observations made every third hour from January 1, 1965, through December 31, 1978. The anemometer was mounted on a ground mast at a height of 6.1 meters. Due to the complex terrain, the data are representative only of the immediate area.

Average annual wind speed at the site was 6.3 miles per hour. Average monthly wind speeds ranged from 4.9 miles per hour in October and November to 7.6 miles per hour in April.

Average annual wind power was 43.0 watts/m². Average monthly wind power ranged from 27.0 watts/m² in October to 65.0 watts/m² in April.

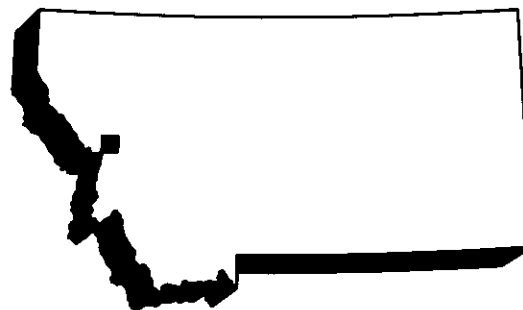


Table IV - 114
Monthly Wind Speed Distribution
MISSOULA COUNTY - MISSOULA NWS AIRPORT
01/01/65 - 12/31/78

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	
CALM (<1.1)	21.1	20.4	13.6	11.3	11.8	11.4	14.0	16.2	18.8	22.8	23.0	22.7	17.2	CALM (<0.5)
1.1- 3.1	2.2	2.4	2.2	1.8	1.7	1.6	1.6	1.8	2.4	3.3	3.0	3.5	2.3	0.5- 1.4
3.4- 5.4	33.6	35.1	30.2	27.1	26.6	29.0	29.5	30.7	33.3	36.6	35.8	34.4	31.8	1.5- 2.4 S
S 5.6- 7.6	18.0	18.9	20.2	18.3	20.4	21.6	20.4	19.4	18.5	17.6	18.7	18.5	19.2	2.5- 3.4 P
P 7.8- 9.8	9.3	8.8	10.9	12.6	12.1	11.5	11.5	10.6	9.8	7.6	7.7	7.1	9.9	3.5- 4.4 E
E 10.1-12.1	5.0	4.4	7.2	8.7	9.1	8.5	7.7	7.1	5.8	4.0	4.2	5.0	6.4	4.5- 5.4 E
E 12.3-14.3	3.8	3.6	5.4	6.5	6.4	6.0	5.5	5.5	4.6	3.1	2.8	3.5	4.7	5.5- 6.4 D
D 14.5-16.6	2.3	2.9	4.6	5.4	5.3	4.6	4.3	3.5	3.4	2.5	2.2	2.3	3.6	6.5- 7.4
16.8-18.8	1.8	1.8	2.8	4.6	3.7	3.5	3.2	2.7	1.8	1.6	1.2	1.4	2.5	7.5- 8.4 M
M 19.0-21.0	1.4	1.0	1.4	2.0	2.0	1.4	1.5	1.6	0.8	0.5	0.7	0.9	1.3	8.5- 9.4 E
I 21.3-23.3	0.6	0.4	1.1	1.0	0.6	0.5	0.6	0.7	0.5	0.2	0.4	0.3	0.6	9.5-10.4 T
L 23.5-25.5	0.4	0.3	0.2	0.3	0.1	0.2	0.1	0.2	0.1	0.0	0.1	0.1	0.2	10.5-11.4 E
E 25.7-27.7	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.1	11.5-12.4 R
S 28.0-30.0	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.2	0.0	0.1	0.1	0.0	0.1	12.5-13.4 S
/ 30.2-32.2	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	13.5-14.4 /
H 32.4-34.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.5-15.4 S
O 34.7-36.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.5-16.4 E
U 36.9-38.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.5-17.4 C
R 39.1-41.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.5-18.4 O
41.4-43.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5-19.4 N
43.6-45.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.5-20.4 D
45.9-56.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.5-25.4
57.0-68.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.5-30.4
68.2-79.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5-35.4
79.4-90.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.5-40.4
>90.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	>40.4
AVERAGE SPEED (MPH)	5.6	5.6	6.9	7.6	7.4	7.2	6.7	6.5	5.8	4.9	4.9	5.1	6.3	
AVERAGE SPEED (M/SEC)	2.5	2.5	3.1	3.4	3.3	3.2	3.0	2.9	2.6	2.2	2.2	2.3	2.8	
AVERAGE WIND POWER (WATTS/M**2)	44.0	35.0	52.0	65.0	55.0	50.0	46.0	45.0	34.0	27.0	29.0	31.0	43.0	

ANEMOMETER HEIGHT = 20.0 FEET = 6.1 METERS

SOURCE: BATTELLE PACIFIC NORTHWEST LABORATORIES

MISSOULA UNIVERSITY OF MONTANA

MISSOULA COUNTY

The University of Montana site was located on the northeastern corner of the University of Montana campus near the mouth of Hellgate Canyon at 46 51 50 N and 113 58 40 W (Site No. 88 on Map II-1). Elevation at the site was 3,198 feet. The site was established by the Montana Air Quality Bureau to monitor wind speed and wind direction as part of the Montana Air Pollution Study.

Wind data collected from May 1, 1978, through March 17, 1980, were available for analysis. The data consist of hourly averages of wind speed and wind direction, obtained by manually reducing information from strip-chart records. The data were gathered by a Climatronics electronic anemometer and wind vane on a 10-meter tower.

Winds were monitored long enough to adequately represent the wind resource at this location. The site, however, is representative only of a limited area near the mouth of Hellgate Canyon. Data recovery, which for the entire period was 83.4 percent, ranged from 33.9 percent in November to 100.0 percent in September.

Average annual wind speed at the site was 6.3 miles per hour. Average monthly wind speeds varied from 5.5 miles per hour in July to 7.5 miles per hour in December.

Average annual wind power was 48.8 watts/m². Average monthly wind power ranged from 19.5 watts/m² in September to 129.7 watts/m² in February.

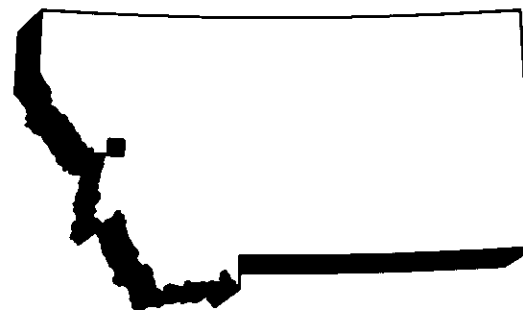


Table IV - 115
Monthly Wind Speed Distribution
MISSOULA COUNTY - MISSOULA UNIVERSITY OF MONTANA
05/01/78 - 03/17/80

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	
CALM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0	CALM
0.1-1.0	0.0	0.8	0.8	0.0	0.1	0.0	0.1	0.0	0.1	0.2	1.6	1.5	0.4	0.1- 0.4
1.1-2.0	5.8	7.6	5.1	1.6	5.1	4.4	4.3	3.6	3.5	4.8	12.3	6.0	5.1	0.5- 0.9
S 2.1-3.0	14.7	16.2	11.3	6.5	15.1	14.0	15.9	16.0	16.8	16.4	16.6	10.5	14.8	1.0- 1.3
P 3.1-4.0	19.4	16.8	16.7	14.2	13.0	16.6	20.4	19.0	17.6	20.0	15.6	12.3	17.1	1.4- 1.8
E 4.1-5.0	12.7	10.9	9.6	9.9	10.0	13.1	13.4	12.4	10.5	9.5	10.2	9.9	11.2	1.9- 2.2
E 5.1-6.0	6.8	6.5	9.4	11.9	8.6	10.2	10.0	9.2	9.0	7.8	8.2	6.6	8.5	2.3- 2.7
D 6.1-7.0	4.2	4.7	8.2	10.1	7.7	7.1	6.2	6.8	7.9	5.5	6.6	4.9	6.4	2.8- 3.1
7.1-8.0	3.8	5.2	6.9	7.6	7.1	8.0	5.5	7.3	6.5	6.5	4.3	6.9	6.4	3.2- 3.6
M 8.1-9.0	4.1	4.5	7.1	9.4	6.4	5.7	5.7	5.5	6.2	6.4	4.5	5.8	5.8	3.7- 4.0
I 9.1-10.0	3.8	3.4	4.3	5.2	6.0	5.7	5.7	4.4	6.1	5.1	3.9	3.8	4.9	4.1- 4.5
L 10.1-11.0	3.7	3.2	4.0	6.3	5.4	4.8	4.8	5.6	4.9	5.2	4.5	5.0	4.8	4.6- 4.9
E 11.1-12.0	3.2	1.7	2.5	4.0	5.1	2.7	2.0	2.3	4.7	4.5	2.0	4.1	3.3	5.0- 5.4
S 12.1-13.0	4.5	2.8	2.8	4.0	3.3	2.8	0.7	1.9	3.1	2.4	1.6	4.5	2.8	5.5- 5.8
/ 13.1-14.0	2.6	2.1	1.1	2.5	2.4	1.0	1.0	1.2	1.6	2.0	1.0	4.1	1.9	5.9- 6.3
H 14.1-15.0	1.6	1.7	1.4	1.3	1.0	1.1	0.7	1.0	0.5	0.9	0.4	2.8	1.2	6.4- 6.7
O 15.1-16.0	1.2	0.9	1.2	1.8	1.3	1.3	0.7	0.5	0.4	1.1	1.2	2.8	1.2	6.8- 7.2
U 16.1-17.0	0.6	0.3	0.9	0.7	0.3	0.5	0.5	0.4	0.1	0.3	1.0	2.1	0.6	7.3- 7.6
R 17.1-18.0	1.4	0.6	0.5	0.0	0.9	0.5	0.8	0.6	0.4	0.4	0.6	1.6	0.7	7.7- 8.0
18.1-19.0	1.3	1.0	0.5	0.4	0.5	0.3	0.1	0.5	0.1	0.1	0.6	1.2	0.5	8.1- 8.5
19.1-20.0	0.3	0.2	0.3	0.7	0.3	0.1	0.3	0.5	0.0	0.0	0.8	1.2	0.3	8.6- 8.9
20.1-25.0	3.2	2.7	2.3	1.8	0.3	0.0	0.9	1.0	0.0	0.5	1.8	1.4	1.1	9.0-11.2
25.1-30.0	0.9	4.2	1.7	0.0	0.0	0.0	0.1	0.1	0.0	0.3	0.2	0.6	0.7	11.3-13.4
30.1-35.0	0.0	1.6	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	13.5-15.6
35.1-40.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.7-17.9
>40.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	>17.9
AVERAGE														
SPEED (MPH)	6.7	7.4	7.1	7.0	6.3	5.8	5.5	5.8	5.6	5.7	5.6	7.5	6.3	
AVERAGE														
SPEED (M/SEC)	3.0	3.3	3.2	3.1	2.8	2.6	2.5	2.6	2.5	2.6	2.5	3.4	2.8	
AVERAGE														
WIND POWER														
(WATTS/M**2)	60.9	129.7	83.8	40.7	30.0	22.6	24.0	28.2	19.5	26.9	39.6	122.4	48.8	
PERCENT DATA														
RECOVERY	82.8	92.9	56.3	61.8	99.0	99.4	99.1	93.4	100.0	99.6	33.9	82.7	83.4	

ANEMOMETER HEIGHT = 10 METERS = 33 FEET
 NUMBER OF OBSERVATIONS = 14136
 PERCENTAGE DATA RECOVERY = 83.4

SOURCE: GEORESEARCH, INC.